

A  
**STEM DISEASE OF TEA**

CAUSED BY

***Nectria Cinnabarina* (Tode) Fr.**

BY

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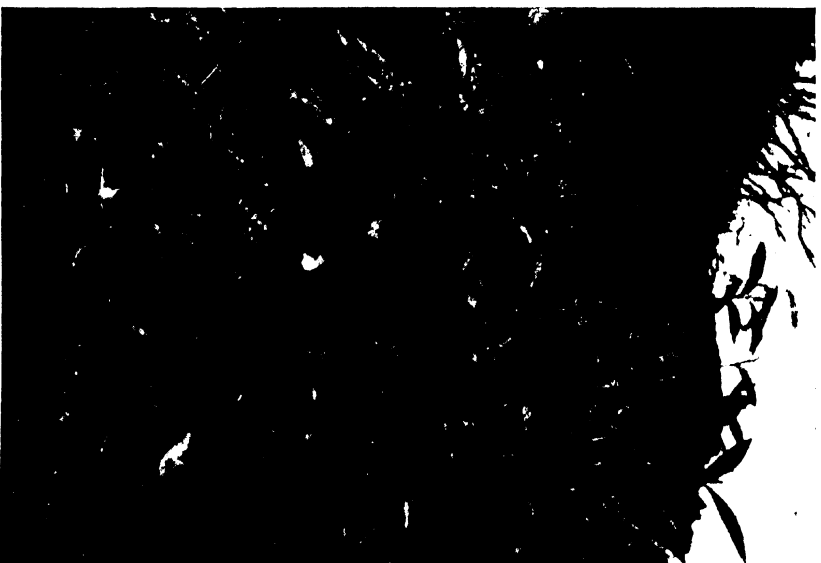
1918.







A tea bush attacked by *Mytilina*.



The same bush after treatment.

## A STEM DISEASE OF TEA CAUSED BY *NECTRIA CINNABARINA* (TODE) Fr.

For many years it had been noticed that the tea in the neighbourhood of certain trees, notably Utis (*Alnus nepalensis*) and Umphi (*Pyralaria edulis*), was frequently unhealthy and it was thought locally that the trees in question secreted some sort of plant poison. It was apparent that the illhealth of the bushes could not in many cases be ascribed to anything connected with the roots of the Umphi or the Utis trees as often fairly deep ditches separated the tea from the trees in question. Nor was the damage confined to the area under the shade or the drip of the trees but seemed to be determined to some extent in the case of fresh outbreaks by the direction of the wind. On some gardens it was found that *Erythrina Spp.* were centres of infection.

Disease associated  
with certain trees.

On investigation it was found that the unhealthy tea was attacked by a fungus, a species of *Nectria*. For a long time however the connection between the fungus on the tea and the trees associated with its occurrence was obscure. It was eventually discovered that the same fungus attacked the flowering shoots of the trees in question.

The damage done by the disease was considerable, especially on some gardens where Utis trees had been planted as wind-breaks.

Damage.

Tea bushes attacked by this fungus become moribund but rarely die right out. The stems die back and the new shoots which arise lower down are generally thin and weakly. In a few cases healthy shoots break away from the collar but these quickly become moribund. The general appearance of the bushes is similar to that of tea very badly attacked by red rust. In a few cases the plants form callosities on the stems in an attempt to repair the damage done by the fungus. These are not however characteristic of the particular disease as they are caused by many agencies.

Symptoms of the  
disease.

The fungus which  
causes the  
disease.

The fungus which causes the disease is either *Nectria cinnabarina* (Tode) Fr. or a very nearly allied species. The fungus attacks the bark of woody stems and the growing layers (between the bark and the wood) and spreads from them down the medullary rays into the pith. The wood is not at first attacked. The fungus does not kill the growing layers at once but gradually starves the infected stems which become moribund and after some months in that state frequently die. The fungus is generally present in the tissues of the plant some distance below the portion obviously diseased. On the death of the shoot, sometimes before, the fruiting stages are produced. These are easily found. They are produced on the bark of the stems. The most noticeable are pink cushions about  $\frac{1}{32}$  of an inch across which are usually produced in profusion. These are called conidiophores and consist of a mass of fungal hyphae or threads arranged together with their ends outwards. The end of each hypha swells slightly and a wall grows beneath the swelling. The swollen end then becomes detached, forming a spore. These spores are called conidiospores and the cushions in which they are borne, conidiophores. Along with the conidiophores another form of fructification is produced—a number of dark red spherical bodies about of an  $\frac{1}{40}$ — $\frac{1}{50}$  inch across. These are produced singly or in groups, sometimes attached to the conidiophores, but more often separately. Examination of these with a lens shows that they each have a small coneshaped aperture. The coneshaped portion collapses slightly in old ones. A more careful examination with a microscope reveals that these bodies are protected by hairy out-growths sometimes minutely roughened. These bodies contain a large number of sausage-shaped sacs each containing eight two-celled spores. The walls of the spores are often minutely striated. These spores measure  $10-15 \frac{1}{10}$ .\* They are called ascospores. The sausage-shaped sacs are asci (Sing. ascus) and the spherical cases perithecia (Sing. perithecium). Still another form of spore is produced. They are long narrow ones measuring  $37-60 \frac{1}{10}$ — $3-5 \frac{1}{10}$ ,\* and are called fusarium spores from their

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\*  $\frac{1}{10} = \frac{1}{1000}$  of a millimeter.



A flowering shoot of *unplhi* (*Pyrola edulis*).









A wind-break of Utis (*Alnus nepalensis*)

shape. They are sometimes found on loose tufts of hyphae round about the perithecia and conidiophores.

The fungus was grown in pure culture from all three kinds of spores and also from mycelium found in the wood and bark of infected tea branches.

Life history of the fungus.

It was most successful on maize meal agar and cane sugar agar. The colour in all cases was white to pink. The conidiophores appeared in 6—8 days but the perithecia were very much later.

On sterilised tea stems the perithecia formed more quickly. *Fusarium* spores were produced freely in all the cultures.

Innoculations with both mycelium and conidiospores were carried out on tea bushes growing at Tocklai and were successful on wounded shoots but not on undamaged ones. From this it may be inferred that the fungus is a wound parasite. It should however be pointed out that the climate of Tocklai is so different from that of Darjeeling that it does not necessarily follow that the fungus cannot infect undamaged shoots there. In any case there would be ample opportunity in either district for the fungus to gain access to the plants, as plucking, of necessity, causes wounds and our experiments at Tocklai prove that such wounds can be infected.

Mode of infection.

It is necessary first of all to remove trees known to harbour the fungus. This is often a difficult thing but as the spores do not seem to travel very far it only appears to be necessary to remove these trees in the neighbourhood of the tea.

Treatment.

The diseased bushes should be pruned to good wood in the cold weather and sprayed with a fungicide immediately after pruning in order to protect the cuts from possible infection. The prunings should all be burned on the spot at once.

The above treatment has been carried out with good results on various gardens. Tea bushes apparently dead frequently come away well after collar pruning.

The fungus may be described technically as follows :—

Perithecia measuring 200-400/ $\mu$ . in diameter ; arising usually in groups, sometimes singly, occasionally arising from conidiophores, otherwise on a stroma, usually cushion-shaped ; dark red, becoming brown and sometimes black with age, spherical, with a conical ostiole, protected by hairs frequently covered with minute granulations. The asci measuring 47-65.7 $\simeq$ 11/ $\mu$  are cylindrical or club-shaped with slightly attenuated apices, containing eight spores which are usually arranged in two rows, oblong, slightly curved, one-septate, colourless, minutely striated lengthwise, measuring 10-15 $\simeq$ 5/ $\mu$ . Conidiospores are pink, cushion-shaped, produced singly or in clusters. Conidiospores are 7.5-10 $\simeq$ 3.3-7.5/ $\mu$ , oval, colourless. Fusarium spores, measuring 37-60 $\simeq$ 3.3-5/ $\mu$ , formed from tufts of mycelium in the neighbourhood of both perithecia and conidiospores, 4-11 septate.

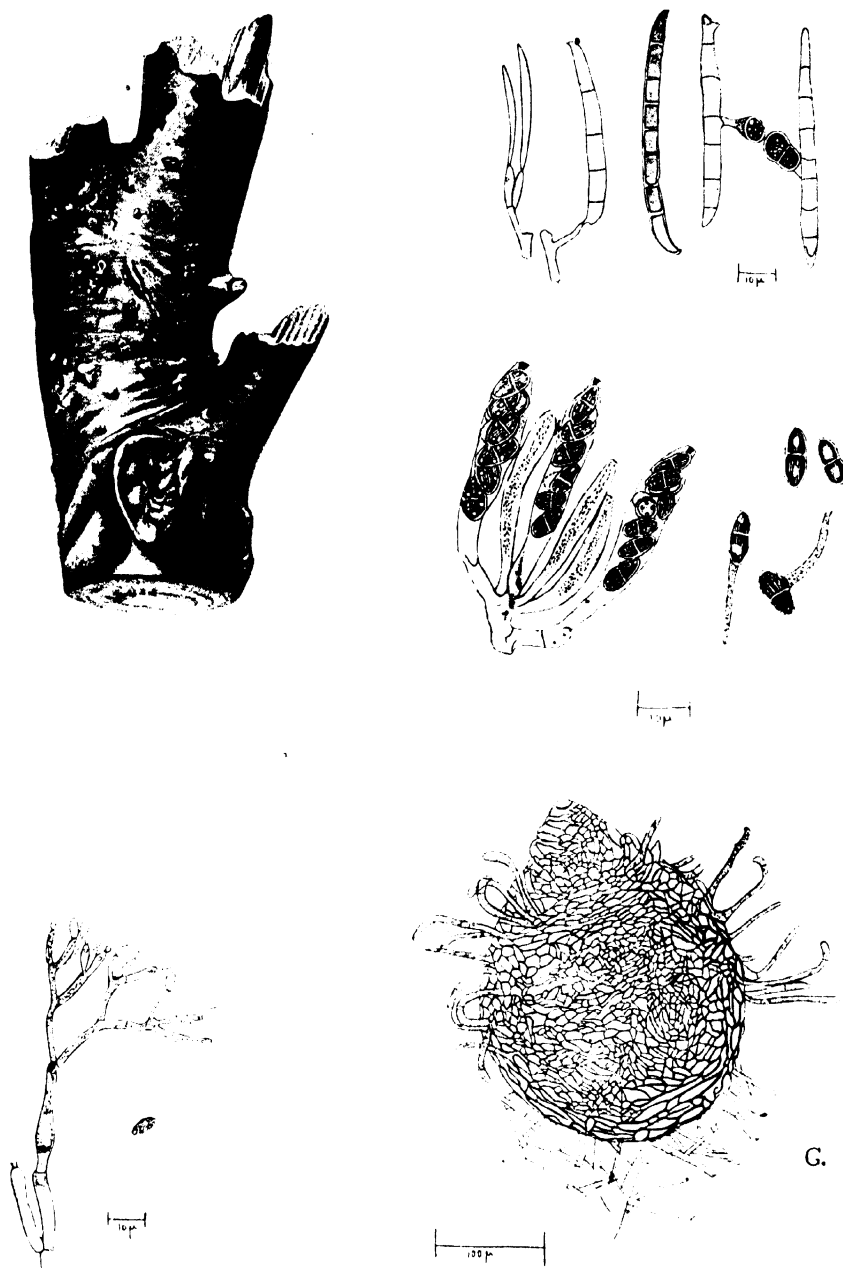
*Nectria cinnabarina* (Tode) Fr. is described in Saccardo as follows (Saccardo II) :—

Peritheciis, caespitosis, confertis, stromate pulviniformi, hemispherico, carnosula, primitus, conidia secernente, instratis, sphaeroidiis, corrugatis, cinnabarinis demum fuscescente—expallentibus, ostiolo papiliformi, ascis cylindraceo—subclavatis, apice leviter attenuatis, 60-90 $\simeq$ 8-12 octosporis, sporidiis distichis vel submonostichis, oblongatis, utrinque obtusis, rectis vel leviter curvulis, uniseptatis hyalinis 14-16 $\simeq$ 5-7) $\mu$ , status conidicus *Tubercularia vulgaris* Tode. Hab in ramis corticatis emortuis arborum et fruticum fere omnium in tota Europa, Ceylon, Siberia, Amer. bor.

Var *levior* Sacc Rel Lib II n 210 : peritheciis minus rugosis in Fraxino Salici etc. in Gallia.

Var *Tiliae* Karst Symb. Myc. Fenn. VI p 239, Sporidiis elongatis curvulis, 18-26 $\simeq$ 4—5.5 in ramis *Tiliae* in Fennia.

Var *obscurata* Rehm Ascom n 184. Peritheciis fuscis vel rubro fuscis ; ascis 75 $\simeq$ 15 sporidiis 20 $\simeq$ 7 cum typo.



*Nectria Cinnabarina* (Tode) Fr. on tea.

The plate shows a tea stem bearing the conidial and perithecial fructifications of the fungus. Beneath this is a drawing of a portion of a conidiophore, bearing spores. Beside this a perithecium is shown—the projecting hairs are marked by minute granulations. Above this is a group of asci with some germinating ascospores. The ascospores are minutely striated. At the top of the plate the fusarium form of fructification is shown. Two of the fusarium spores are connected to spore-like outgrowths.



The fungus is described by Wilson and Seaver in N. American flora as follows :—

Stromata, erumpent, tubercular, at first pinkish or yellowish red, becoming darker with age, often brownish and occasionally quite black  $1\text{--}2/\mu$  in diameter and  $1\text{--}2/\mu$  high. Conidiophores  $50\text{--}100/\mu$  long without lateral branches on which the conidia are borne; conidia  $4\text{--}6\text{--}2/\mu$  ellipsoid, hyaline; perithecia springing at first from the base of the stroma, which at maturity is covered by the cespitose clusters of perithecia; individual perithecia nearly globose, with the ostiolum rather prominent, becoming slightly collapsed, and at first cinnabar red, becoming darker with age, often brown and occasionally black (when withered), roughened externally with coarse granules,  $375\text{--}400/\mu$  in diameter, asci clavate  $50\text{--}90\text{--}7\text{--}12/\mu$  8 spored; spores mostly 2-seriate, ellipsoid, elongate, about 3 times as long as broad, with obtuse ends, 1-septate hyaline, mostly a little curved,  $12\text{--}20\text{--}4\text{--}6$  long, paraphyses very delicate.

Seaver who has worked on the fungus in America states that the following are synonyms for the same fungus to which he gives the name *Creonectria purpurea* :—

<i>Tremella purpurea</i> L. Sp., Pl 2: 1158	...	...	A. D. 1753
<i>Sphaeria tremelloides</i> Weigel Obs Bot. 46	...	...	" 1772
<i>Tubercularia vulgaris</i> Tode Fungi Meekl 1: 18	...	...	" 1790
<i>Sphaeria cinnabarina</i> " " 219	...	...	" 1791
<i>Cucurbitaria cinnabarina</i> Greville, Scot Fl Crypt 3: 136	...	...	" 1825
<i>Nectria cinnabarina</i> Fries, Summa Veg Scand 388	...	...	" 1849
" <i>Sambuci</i> Ellis & Evertr. Proc. Acad. Nat. Sci. Phil.			
1890: 246	...	...	" 1891
" <i>meliae</i> Earle, Bull. Torrey Club 25, 364	...	...	" 1898
" <i>Russellii</i> Berk & Br. Grevillea 4: 45	...	...	" 1875
" <i>offuscata</i> Berk & Curtis 4: 45	...	...	" 1878
" <i>nigrescens</i> Cooke " 7: 50	...	...	" 1878
<i>Sphaeria dematiosa</i> Schw Trans Am Phil Soc. II 4: 205	1832	...	" 1890
" <i>celastri</i> Schw. Fries; El. Fung. 2: 81	...	...	" 1827
<i>Nectria purpurea</i> (L) Wilson & Seaver, Jour. Myc. 13: 51	...	{	" 1907
		"	" 1908

From a study of the various descriptions it would appear that the fungus varies considerably and the difference between the type and our specimens is not sufficient to warrant a new species being made. The markings on the hairs mentioned above do not seem to have been noted by other investigators of *Nectria cinnabarina* but as in our specimens they are not always present they cannot be considered characteristic.